CALIFORNIA. DIVISION OF MINES & GEOLOGY. SPECIAL REPORT.

Mineral Land Classification of the Greater Los Angeles Area

PART I: DESCRIPTION OF THE MINERAL LAND CLASSIFICATION PROJECT OF THE GREATER LOS ANGELES AREA

PART II: CLASSIFICATION OF SAND AND GRAVEL RESOURCE AREAS, SAN FERNANDO VALLEY PRODUCTION-CONSUMPTION REGION

1979

CALIFORNIA DIVISION OF MINES AND GEOLOGY

SPECIAL REPORT 143

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FOREWORD

by James F. Davis

This report, "Classification of Sand and Gravel Resource Areas – San Fernando Valley Production–Consumption Region," is the first analysis by the California Division of Mines and Geology (CDMG) to be provided to the State Mining and Geology Board and to the local governments which regulate land use in this region. The report has been developed under the Surface Mining and Reclamation Act of 1975, which was enacted by the legislature to assure adequate mined land reclamation and mineral resource conservation under the auspices of the Mining and Geology Board and CDMG.

The Mining and Geology Board enacted Guidelines in June 1978 to be employed by CDMG in its mineral resource classification. This report embodies the intent of those directives. The undertaking is of signal importance in economic geology, because it deals with very specific mineral resource conservation issues in an area of intensive land use.

James F. Davis

State Geologist

PREFACE

The Los Angeles metropolitan area, with a population of nearly 10 million people, is the largest urbanized area in California. This region includes the southern part of Los Angeles County and parts of San Bernardino, Riverside, and Orange Counties. Although substantial parts of the Los Angeles area have been developed, wide–spread urbanization is still occurring at a rapid rate.

In any metropolitan or rural region undergoing urban development, it is of paramount importance that adequate supplies of mineral commodities be readily available. Minerals used in construction, particularly sand, gravel, or stone used in concrete, must be available in large quantities at reasonable costs. For many years, the Los Angeles area has been fortunate because adequate quantities of low–cost aggregate materials, chiefly sand and gravel, have been available locally. However, as more and more areas became urbanized, available sand and gravel deposits suitable as sources of low–cost aggregate are increasingly threatened with loss through urban development in addition to exhaustion by mining.

The principal objective of this project is to classify land in the Los Angeles area into Mineral Resource Zones based on guidelines adopted by the California State Mining and Geology Board. This classification project will assist the State Mining and Geology Board, as mandated by the Surface Mining and Reclamation Act of 1975, in designating lands that are most needed for their mineral content. This designation process, in turn, has been designed to assist and guide local lead agencies in preserving those essential mineral resources for future use through proper zoning ordinances.

Information will be submitted to the State Mining and Geology Board in a series of parts covering six Production–Consumption regions that have been identified in the greater Los Angeles metropolitan area. Part I is an introductory section describing the background, purpose, and scope of the overall project. Part II presents the classification of sand and gravel resource areas in the San Fernando Valley Production–Consumption region. Information in Part II includes maps showing the locations of significant sand and gravel deposits of the San Fernando Valley Production–Consumption region, as well as tables, charts and discussions, that present data on population, production, aggregate consumption, future requirements, and estimates of aggregate resources. Subsequent parts of this project will classify remaining Production–Consumption regions of the Los Angeles area.

It is suggested that the reader also refer to California Division of Mines and Geology Open–file Report 77–1LA, Aggregates in the Greater Los Angeles Area (Evans and others: CDMG Special Report 139 [in press]). This report describes and evaluates the significance, uses, prices, marketing, transportation, supply, and other factors that relate to the aggregate industry of the greater Los Angeles metropolitan area.

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Glossary of Terms
adapted from American Geological Institute

GLOSSARY OF GEOLOGY

aggregate: Any of several hard, inert, construction materials (such as sand, gravel, shells, slag, crushed stone, or other mineral material), or combinations thereof, used for mixing in specified size distributions with a cementing or bituminous material to form such products as concrete, asphaltic concrete, mortar, and plaster.

alluvial fan: A low, outspread, relatively flat to gently sloping deposit of sand and gravel, and shaped in aerial view like an open fan or a segment of a cone, normally deposited by a stream with its apex at the place where the stream issues from a narrow mountain valley upon a plain or broad valley.

alluvial terrace: A stream terrace composed of unconsolidated alluvium (including gravel), produced by renewed downcutting of the flood plain by a rejuvenated stream.

alluviation: The process of deposition or formation of alluvium or alluvial features at places where stream velocity is decreased or streamflow is checked.

alluvium: A general term for clay, silt, sand, gravel or similar unconsolidated detrital material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semisorted sediment.

asphaltic concrete: Mixed asphalt (binder) and crushed stone, gravel, and sand used for paving and roofing.

base level: The lowest level toward which erosion of a region of the Earth's surface constantly progresses but seldom, if ever, reaches; especially the level below which a stream cannot erode its bed. The general, or ultimate base level for the land surface is sea level, but temporary base levels may exist regionally.

base material: Specified material (coarse gravel, crushed stone) used in the construction of the base course, a bottom layer designed for one or more functions such as distributing load, providing drainage, and minimizing frost action.

basement rock: An assemblage of undifferentiated rocks that underlies the younger, sedimentary deposits in the area. The basement rocks are igneous and metamorphic in origin.

basin: A depressed area in which sediments accumulate.

bedrock: A general term for the rock, usually solid, that underlies soil or other unconsolidated material.

Cenozoic: An era of geologic time, from the end of the Mesozoic to the present. Considered to have begun about 70 million years ago.

coalescing alluvial fans: A series of alluvial fans forming a broad, continuous, gently inclined surface extending along and from the base of a mountain range out into and around an inland basin.

consolidation: Any process whereby loosely arranged, soft, or liquid earth materials become firm and coherent rock.

construction materials: Natural and manufactured industrial mineral and rock materials used by the construction industry. These materials include: aggregates (crushed stone, sand and gravel, lightweight aggregate, and slag), cement and cement raw materials, dimension and cut stone, granules, gypsum and anhydrite, and insulating materials.

crystalline rock: An igneous or metamorphic rock consisting wholly of interlocking crystals. Igneous rocks develop through cooling from a molten state. Metamorphic rocks have undergone recrystallization as a result of temperature and pressure changes.

deposit: Material of any type or from any source that has accumulated by some natural process or agent, either in the form of consolidated or unconsolidated material.

GLOSSARY OF GEOLOGY
(continued)

detrital: Pertaining to or formed from detritus, which is loose rock and mineral material (gravel, sand, silt, and clay) that is worn off or removed from older rocks and moved from its place of origin.

deuteric: A water–associated alteration process that occurs during the late stages of crystallization of an igneous rock. Certain minerals composing the rock may react or be transformed into different minerals.

distal: Formed farthest from the source area.

gabbro: A dense, dark crystalline igneous rock – the intrusive equivalent of basalt.

granitic gneiss: A metamorphic rock that has a mineral composition similar to granite.

"hardpan": A term used loosely to designate any relatively hard layer that is difficuult to excavate or drill.

indurated: Term applied to a deposit that has been hardened by the action of pressure, cementation, and heat.

intrusion: The process of emplacement of molten rock in pre–existing rock.

lens: A geologic deposit bounded by converging surfaces (at least one of which is curved), thick in the middle and thinning out toward the edges, resembling a convex lens.

massive unit: Sedimentary rock that occurs in very thick, homogeneous beds; sedimentary rock that is obscurely bedded or seems to be without internal structure.

Mesozoic: An era of time, from the end of the Paleozoic to the beginning of the Cenozoic (about 280 million years ago to 70 million years ago).

Paleozoic; An era of geologic time, from the end of the Precambrian to the beginning of the Mesozoic (about 600 million years ago to 280 million years ago).

petrographic analysis: Description and systematic classification of rocks by means of microscopic examination of thin sections of rocks.

Precambrian: All geologic time before the beginning of the Paleozoic.

Quaternary: The second period of the Cenozoic era (following the Tertiary), thought to cover last two or three million years.

rejuvenated: A stream stimulated to renewed erosive activity, as by uplift or by a drop of sea level; stream that has reverted to the activities and forms of a more youthful stage.

source area: The area from which the constituent materials of a sedimentary rock are derived.

tectonism: General term for all movement of the crust produced by Earth forces, including the formation of ocean basins, continents, plateaus, and mountain ranges.

terrace: A relatively level or gently inclined surface, generally less broad than a plain, that commonly occurs along the margin and above the level of a body of water, marking a former water level.

terrane: Term applied to a rock or group of rocks and to the area in which it outcrops.

Tertiary: The first period of the Cenozoic era, thought to have covered the time span between 65 and three to two million years ago.

wash: A broad, shallow, gravelly or stony, normally dry bed of an intermittent stream.

youthful: First stage in the development of a stream, characterized by active and rapid downcutting, forming a deep, narrow, steep–walled, V–shaped valley with a steep and irregular gradient.

zeolite: A large group of white or colorless minerals that commonly occur as secondary minerals filling cavities and coating cracks in basaltic lavas and other rocks.

zeolitization: Introduction of, or replacement by, a mineral (or minerals) of the zeolite group.

PART I

DESCRIPTION OF THE MINERAL LAND CLASSIFICATION PROJECT OF THE GREATER LOS ANGELES AREA

PART I

DESCRIPTION OF THE MINERAL LAND CLASSIFICATION PROJECT OF THE GREATER LOS ANGELES AREA

BACKGROUND AND PURPOSE

.n expansion has been a major contributing factor to the significant mineral resources in past years. This has hap- ›ecause land–use planning decisions have been made with ˆ any, knowledge about the underlying deposits and the ınce they hold in supplying the needs of the community. onse to the problem of conflicting land use and the essen- d for mineral extraction, the California Legislature enact- Surface Mining and Reclamation Act (SMARA) of 1975 ppendix A–1). SMARA requires the State Geologist to ', according to the presence or absence of significant min- posits, certain areas of the State subject to urban expan- · other irreversible land uses incompatible with mining.[1] ızing areas are identified by the State Office of Planning :search (OPR) and the State Mining and Geology Board.

State Mining and Geology Board, upon receipt of the cation information from the State Geologist, consults ıe appropriate lead agencies and other interested parties. this consultation, the State Mining and Geology Board esignate identified mineral deposits in classified areas as of statewide or regional significance.[2] The objective of the ıcation and designation process is to assist local govern- n preserving for the future essential mineral resources that otherwise be unavailable when needed.

January 13, 1978, the State Mining and Geology Board ›d Resolution No. 22, *Priorities for Mineral Lands Clas- ion* (revised November 2, 1978), which scheduled the gen- rder of work for the State Geologist to classify different within the State (Appendix A–2). The priorities for clas- ion were determined by the Board in response to OPR– fied urbanizing areas, by events that created conditions hreaten availability of significant mineral resources, or by ›ns that may be accepted by the Board.

: *Guidelines for Classification and Designation of Mineral* s were adopted by the State Mining and Geology Board on 30, 1978 (Appendix A–3). The purpose of these guidelines ›rovide direction to the State Geologist in carrying out the fication of mineral land, and to establish procedures for the ıation process. Section I.1a of the guidelines requires that ate Geologist classify specified areas into *Mineral Resource* s (MRZ) or *Scientific Resource Zones* (SZ) as defined in ›n I.2 of the guidelines (Appendix A–3). In addition, Sec- ..3 of the guidelines requires that mineral land classification reports presenting areas classified as containing significant deposits used as construction material (sand, gravel, and crushed stone) include information about (1) the location and estimated total quantity of construction material that is geologically available for mining, (2) limits of the market (consumption) region which the potentially producible commodity would serve, and (3) an estimate of the total quantity of material that will be needed to supply the requirements of the county and consumption region for the next 50 years. This information will assist the State Mining and Geology Board in determining the significance of these types of deposits, which are usually referred to as common minerals.

The Mineral Land Classification of the Greater Los Angeles Area was initiated in October 1978 by the State Geologist. The project area includes metropolitan portions of Los Angeles, Orange, San Bernardino, and Riverside Counties (Figure 1.1). Sand, gravel, and crushed aggregate resources of the area are selected for initial consideration in the classification project. Other mineral resources will be considered collectively following the initial classification.

In keeping with the concept of statewide or regional significance of a particular mineral deposit, each major sand and gravel deposit in the Los Angeles area will be evaluated separately. Hence, the overall Los Angeles area project was divided into separate regions on the basis of existing aggregate production and consumption patterns. Six Production–Consumption region (P–C region) studies will be completed according to priorities and time schedules established by the State Geologist. Results for each P–C region will be submitted to the State Mining and Geology Board as they are completed. According to a five–year plan submitted to the legislature, the delivery date for the classification for all mineral resource commodities in the Los Angeles area is June 1983.

In order to fully evaluate the aggregate supply and demand of each P–C region, the adjacent P–C regions must also be considered. Consequently, some work will be done concurrently for all P–C regions.

REFINING PROJECT BOUNDARIES

Maps supplied by the State Office of Planning and Research (OPR) served to identify urbanized and urbanizing areas within the greater Los Angeles area (Plate 1.1). Because these maps were produced several years ago, their boundaries had to be modified to reflect current conditions. This was accomplished by contacting local lead agencies and by studying recent aerial photographs to determine where urbanization had occurred since the OPR maps were issued. Modified boundaries are shown on quadrangle maps that accompany each P–C region study.

[1] *:sification* is the process of identification of lands containing significant min- deposits.
[2] *ignation* is the formal recognition by the State Mining and Geology Board, · consultation with lead agencies and other interested parties, of areas con- ıng mineral deposits of regional or statewide significance that should be ected from land uses incompatible with mineral extraction.

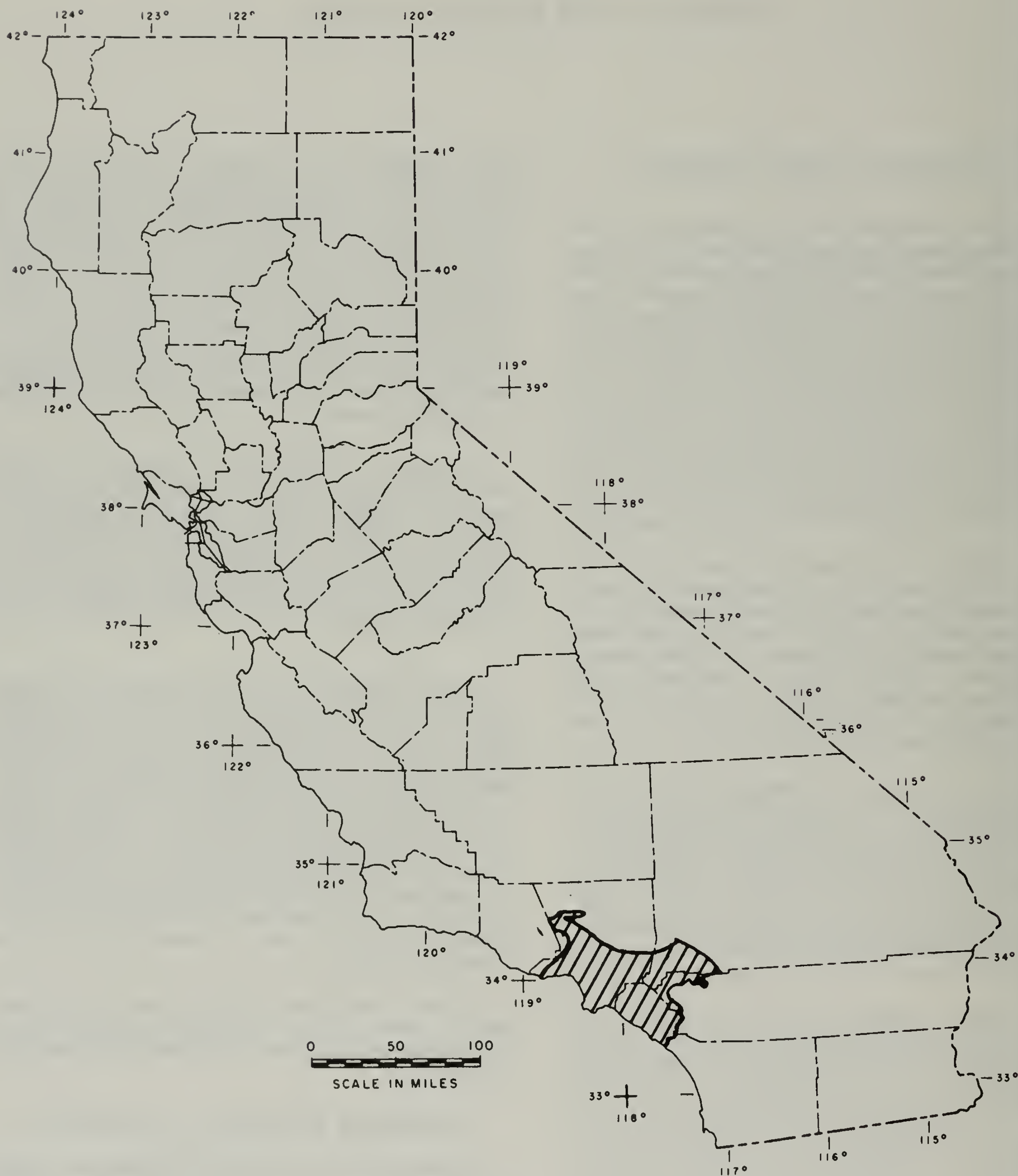


FIGURE 1.1 Project boundaries: Mineral Land Classification of the Greater Los Angeles Area.

TERMINATION OF PRODUCTION–CONSUMPTION REGIONS

Marketing Regions

rder to study supply–demand relationships of a mineral odity, it is necessary to know where the commodity is ed and where it is consumed. Some mineral commodities, the borate deposits of Death Valley, have a worldwide area and, therefore, have worldwide significance. er, low value bulk commodities, such as sand and gravel, rketed more locally, thus requiring their significance to be ed on a regional level.

ge metropolitan areas usually obtain sand and gravel for iction purposes from several local sources. The greater ngeles metropolitan area obtains its aggregate needs from 50 aggregate plants clustered in six major sand and gravel tion districts (Figure 1.2). The plants operate within the ction boundaries of 17 lead agencies (13 city governments county governments; Table 1.1). Since the producers with- ajor production district generally share a common market , the collective group, rather than the individual producer, ed as the basic aggregate–producing unit in this study. On bases, the greater Los Angeles area was divided into six te aggregate "Production–Consumption" (P–C) regions.

Transportation Rates

neralized P–C region boundaries were based upon a com- ve analysis of the haulage costs for the different production ts in the area. These costs generally follow minimum ortation rates that are reported and periodically updated State of California Public Utilities Commission (PUC) in s of publications called Minimum Rate Tariffs (MRT). f these publications, MRT 17A (PUC, 1972), fixes mini- transportation rates for the delivery of aggregate products lependent trucking firms in southern California. Although UC minimum rates do not apply to aggregate producers ransport their own product, the producers use the PUC num rates as guidelines for haulage rates. The schedule of contained in MRT 17A is based on both the mileage and nvolved for delivery. MRT 17A is accompanied by a series ps that divide the Los Angeles area into relatively small product delivery zones keyed to the MRT listing by code er.

e minimum transportation rates set by MRT 17A and the priate *Rock Products Delivery Zones* maps were used in resent study to aid in the determination of general P–C n boundaries. First, the minimum transportation rates for oduction localities were plotted on the delivery zones maps. P–C region boundaries were drawn along the rock product ery zones according to which production district could r aggregate at the least fixed minimum rate.

djustment of P–C Region Boundaries

e boundaries established by the above method are highly alized, and many parts of the P–C region are served from ple production localities. Furthermore, companies can, and

LOS ANGELES COUNTY

Alhambra	Hawaiian Gardens	Paramount
Arcadia	Hawthorne	*Pasadena
Artesia	Hermosa Beach	Pico Rivera
*Azusa	Hidden Hills	Pomona
Baldwin Park	Hollydale	Rancho Palos Verdes
Bell	Huntington Park	Redondo Beach
Bellflower	Industy	Rolling Hills
Bell Gardens	Inglewood	*Rolling Hills Estates
Beverly Hills	*Irwindale	Rosemead
Bradbury	La Canada Flintridge	San Dimas
Burbank	Lakewood	San Fernando
Carson	La Mirada	San Gabriel
Cerritos	La Puente	San Marino
Claremont	La Verne	Santa Fe Springs
Commerce	Lawndale	Santa Monica
Compton	Lomita	Sierra Madre
Covina	Long Beach	Signal Hill
Cudahy	*Los Angeles	Southgate
Culver City	Lynwood	South Pasadena
Downey	Manhattan Beach	Temple City
Duarte	Maywood	Torrance
*El Monte	Monrovia	Vernon
El Segundo	Montebello	West Covina
Gardena	Monterey Park	Whittier
Glendale	Norwalk	
Glendora	Palos Verdes Estates	

ORANGE COUNTY

Anaheim	Huntington Beach	San Clemente
Brea	Laguna Beach	*San Juan Capistrano
Buena Park	La Habra	Santa Ana
Costa Mesa	La Palma	Seal Beach
Cypress	Los Alamitos	Stanton
Fountain Valley	Newport Beach	Tustin
Fullerton	*Orange	Villa Park
Garden Grove	Placentia	Westminster

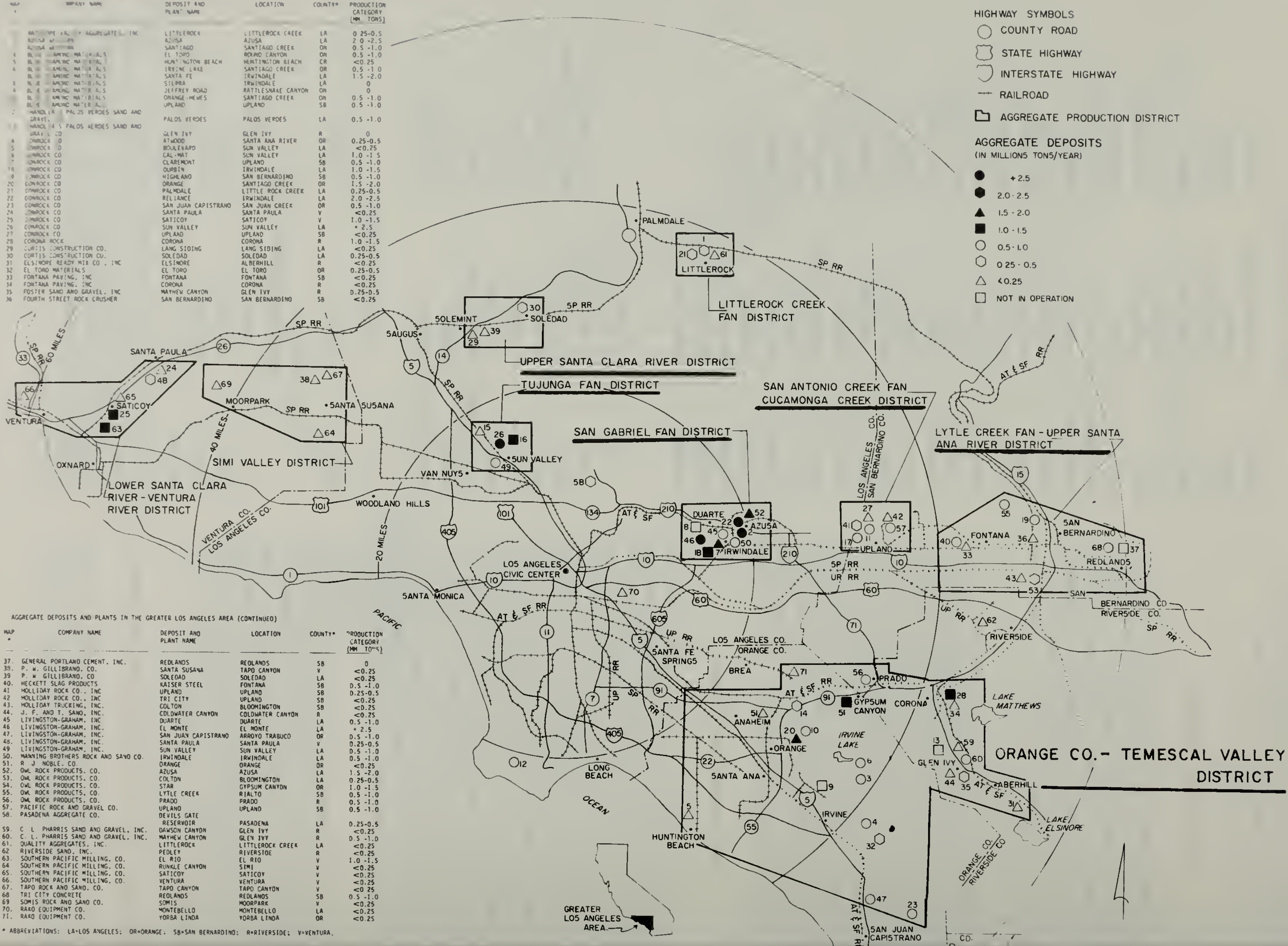
RIVERSIDE COUNTY

Corona	Norco	Riverside

SAN BERNARDINO COUNTY

Alta Loma	Fontana	Rancho Cucamonga
Chino	Loma Linda	*Redlands
*Colton	Montclair	Rialto
Etiwanda	Ontario	*San Bernardino
		*Upland

TABLE 1.1 List of lead agencies (county and incorporated city governments) located within or adjacent to the project boundaries of the Mineral Land Classification of the Greater Los Angeles Area. (Cities that have active aggregate operations within their jurisdictional boundaries are denoted by asterisks.)



AGGREGATE DEPOSITS AND PLANTS IN THE GREATER LOS ANGELES AREA

MAP #	COMPANY NAME	DEPOSIT AND PLANT NAME	LOCATION	COUNTY*	PRODUCTION CATEGORY (MM TONS)
1	[illegible] AGGREGATES, INC	LITTLEROCK	LITTLEROCK CREEK	LA	0.25-0.5
2	AZUSA [illegible]	AZUSA	AZUSA	LA	2.0 -2.5
3	AZUSA [illegible]	SANTIAGO	SANTIAGO CREEK	OR	0.5 -1.0
4	[illegible] MATERIALS	EL TORO	ROUND CANYON	OR	0.5 -1.0
5	[illegible] MATERIALS	HUNTINGTON BEACH	HUNTINGTON BEACH	OR	<0.25
6	[illegible] MATERIALS	IRVINE LAKE	SANTIAGO CREEK	OR	0.5 -1.0
7	[illegible] MATERIALS	SANTA FE	IRWINDALE	LA	1.5 -2.0
8	[illegible] MATERIALS	SILURA	IRWINDALE	LA	0
9	[illegible] MATERIALS	JEFFREY ROAD	RATTLESNAKE CANYON	OR	0
10	[illegible] MATERIALS	ORANGE-HEWES	SANTIAGO CREEK	OR	0.5 -1.0
11	[illegible] MATERIALS	UPLAND	UPLAND	SB	0.5 -1.0
12	[illegible] PALOS VERDES SAND AND GRAVEL	PALOS VERDES	PALOS VERDES	LA	0.5 -1.0
13	[illegible] PALOS VERDES SAND AND GRAVEL CO	GLEN IVY	GLEN IVY	R	0
14	CONROCK CO	ATWOOD	SANTA ANA RIVER	OR	0.25-0.5
15	CONROCK CO	BOULEVARD	SUN VALLEY	LA	<0.25
16	CONROCK CO	CAL-MAT	SUN VALLEY	LA	1.0 -1.5
17	CONROCK CO	CLAREMONT	UPLAND	SB	0.5 -1.0
18	CONROCK CO	DURBIN	IRWINDALE	LA	1.0 -1.5
19	CONROCK CO	HIGHLAND	SAN BERNARDINO	SB	0.5 -1.0
20	CONROCK CO	ORANGE	SANTIAGO CREEK	OR	1.5 -2.0
21	CONROCK CO	PALMDALE	LITTLE ROCK CREEK	LA	0.25-0.5
22	CONROCK CO	RELIANCE	IRWINDALE	LA	2.0 -2.5
23	CONROCK CO	SAN JUAN CAPISTRANO	SAN JUAN CREEK	OR	0.5 -1.0
24	CONROCK CO	SANTA PAULA	SANTA PAULA	V	<0.25
25	CONROCK CO	SATICOY	SATICOY	V	1.0 -1.5
26	CONROCK CO	SUN VALLEY	SUN VALLEY	LA	+ 2.5
27	CONROCK CO	UPLAND	UPLAND	SB	<0.25
28	CORONA ROCK	CORONA	CORONA	R	1.0 -1.5
29	CURTIS CONSTRUCTION CO.	LANG SIDING	LANG SIDING	LA	<0.25
30	CURTIS CONSTRUCTION CO.	SOLEDAD	SOLEDAD	LA	0.25-0.5
31	ELSINORE READY MIX CO., INC	ELSINORE	ALBERHILL	R	<0.25
32	EL TORO MATERIALS	EL TORO	EL TORO	OR	0.25-0.5
33	FONTANA PAVING, INC	FONTANA	FONTANA	SB	<0.25
34	FONTANA PAVING, INC	CORONA	CORONA	R	<0.25
35	FOSTER SAND AND GRAVEL, INC	MAYHEW CANYON	GLEN IVY	R	0.25-0.5
36	FOURTH STREET ROCK CRUSHER	SAN BERNARDINO	SAN BERNARDINO	SB	<0.25

AGGREGATE DEPOSITS AND PLANTS IN THE GREATER LOS ANGELES AREA (CONTINUED)

MAP #	COMPANY NAME	DEPOSIT AND PLANT NAME	LOCATION	COUNTY*	PRODUCTION CATEGORY (MM TONS)
37.	GENERAL PORTLAND CEMENT, INC.	REDLANDS	REDLANDS	SB	0
38.	P. W. GILLIBRAND, CO.	SANTA SUSANA	TAPO CANYON	V	<0.25
39	P. W GILLIBRAND, CO	SOLEDAD	SOLEDAD	LA	<0.25
40.	HECKETT SLAG PRODUCTS	KAISER STEEL	FONTANA	SB	0.5 -1.0
41	HOLLIDAY ROCK CO., INC	UPLAND	UPLAND	SB	0.25-0.5
42	HOLLIDAY ROCK CO., INC	TRI CITY	UPLAND	SB	<0.25
43.	HOLLIDAY TRUCKING, INC.	COLTON	BLOOMINGTON	SB	<0.25
44.	J. F. AND T. SAND, INC.	COLDWATER CANYON	COLDWATER CANYON	R	<0.25
45	LIVINGSTON-GRAHAM, INC	DUARTE	DUARTE	LA	0.5 -1.0
46	LIVINGSTON-GRAHAM, INC.	EL MONTE	EL MONTE	LA	+ 2.5
47.	LIVINGSTON-GRAHAM, INC.	SAN JUAN CAPISTRANO	ARROYO TRABUCO	OR	0.5 -1.0
48.	LIVINGSTON-GRAHAM, INC.	SANTA PAULA	SANTA PAULA	V	0.25-0.5
49	LIVINGSTON-GRAHAM, INC.	SUN VALLEY	SUN VALLEY	LA	0.5 -1.0
50.	MANNING BROTHERS ROCK AND SAND CO.	IRWINDALE	IRWINDALE	LA	0.5 -1.0
51.	R J NOBLE, CO.	ORANGE	ORANGE	OR	<0.25
52.	OWL ROCK PRODUCTS, CO.	AZUSA	AZUSA	LA	1.5 -2.0
53.	OWL ROCK PRODUCTS, CO.	COLTON	BLOOMINGTON	LA	0.25-0.5
54.	OWL ROCK PRODUCTS, CO.	STAR	GYPSUM CANYON	OR	1.0 -1.5
55.	OWL ROCK PRODUCTS, CO.	LYTLE CREEK	RIALTO	SB	0.5 -1.0
56.	OWL ROCK PRODUCTS, CO.	PRADO	PRADO	R	0.5 -1.0
57.	PACIFIC ROCK AND GRAVEL CO.	UPLAND	UPLAND	SB	0.5 -1.0
58.	PASADENA AGGREGATE CO.	DEVILS GATE RESERVOIR	PASADENA	LA	0.25-0.5
59.	C L PHARRIS SAND AND GRAVEL, INC.	DAWSON CANYON	GLEN IVY	R	<0.25
60.	C. L. PHARRIS SAND AND GRAVEL, INC.	MAYHEW CANYON	GLEN IVY	R	0.5 -1.0
61.	QUALITY AGGREGATES, INC.	LITTLEROCK	LITTLEROCK CREEK	LA	<0.25
62	RIVERSIDE SAND, INC.	PEDLEY	RIVERSIDE	R	<0.25
63.	SOUTHERN PACIFIC MILLING, CO.	EL RIO	EL RIO	V	1.0 -1.5
64	SOUTHERN PACIFIC MILLING, CO.	RUNKLE CANYON	SIMI	V	<0.25
65.	SOUTHERN PACIFIC MILLING, CO.	SATICOY	SATICOY	V	<0.25
66.	SOUTHERN PACIFIC MILLING, CO.	VENTURA	VENTURA	V	<0.25
67.	TAPO ROCK AND SAND, CO.	TAPO CANYON	TAPO CANYON	V	<0.25
68	TRI CITY CONCRETE	REDLANDS	REDLANDS	SB	0.5 -1.0
69	SOMIS ROCK AND SAND CO.	SOMIS	MOORPARK	V	<0.25
70.	RAKO EQUIPMENT CO.	MONTEBELLO	MONTEBELLO	LA	<0.25
71.	RAKO EQUIPMENT CO.	YORBA LINDA	YORBA LINDA	OR	<0.25

* ABBREVIATIONS: LA=LOS ANGELES; OR=ORANGE; SB=SAN BERNARDINO; R=RIVERSIDE; V=VENTURA.

rge higher transportation rates than the minimum rates ?UC. Varying transportation charges, as well as other such as low bidding, plant capacity and hauling capabili- ıld significantly alter the above P–C region boundaries.

der to take these factors into consideration and to test the ıethodology, recent-year delivery records of cooperating rs were examined on a confidential basis. For the most ımpany records verified that the bulk of production dis- gregate deliveries fell within the calculated P–C region ries. However, some modifications had to be made along ɔrtions of the boundary lines. For example, modification ne segment of a P–C region boundary was made because one production district proved to be higher within an t P–C region. Subsequent investigation showed that a batch plant belonging to the adjacent production district within the area of the other, thereby lowering costs. In er case, aggregate sales from a relatively large production completely dominated the area surrounding a smaller tion district. The reason was found to be that the smaller tion district was deficient in coarse material and was, re, unable to supply the demand. Consequently, the production district was incorporated into the P–C region larger district.

lized P–C regions established for the present study are on Plate 1.2. An index map showing relationships of P–C boundary lines to the 7–½ minute quadrangle maps cov- ı this project is presented in Figure 1.3. A list of the ngles is presented in Table 1.2.

MINERAL RESOURCE ZONE CATEGORIES

ɜral Resource Zones (MRZ–1, MRZ–2, MRZ–3, MRZ– Scientific Zones (SZ) that appear on quadrangles that ɔany each P–C region report are determined on the basis ɛria set forth in the *Guidelines for Classification and ation of Mineral Lands* (Appendix A–3).

guidelines for establishing the Mineral Resource Zones o set forth below:

ɅRZ–1 Areas where adequate information indicates that ıo significant mineral deposits are present, or where it is udged that little likelihood exists for their presence. This :one shall be applied where well developed lines of reason- ng, based upon economic geologic principles and adequate lata, demonstrate that the likelihood for occurrence of ıignificant mineral deposits is nil or slight.

ʍRZ–2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists. This zone shall be applied to known mineral deposits or where well developed lines of reasoning, based upon economic– geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral depos- its is high.

MRZ–3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.

1.	Val Verde	35.	Yucaipa
2.	Newhall	36.	Venice
3.	Mint Canyon	37.	Inglewaad
4.	Agua Dulch	38.	Sauth Gate
5.	Oat Mtn.	39.	Whittier
6.	San Fernando	40.	La Habra
7.	Sunland	41.	Yarba Linda
8.	Candar Peak	42.	Prada Dam
9.	Calabasas	43.	Carana North
10.	Canoga Park	44.	Riverside West
11.	Van Nuys	45.	Riverside East
12.	Burbank	46.	Sunnymead
13.	Pasadena	47.	Redando Beach
14.	Mt. Wilson	48.	Tarrance
15.	Azusa	49.	Lang Beach
16.	Glendora	50.	Las Alamitas
17.	Mt. Baldy	51.	Anaheim
18.	Cucumanga Peak	52.	Orange
19.	Devare	53.	Black Star Canyan
20.	San Bernardina	54.	Carana Sauth
21.	Harrisan Mtn.	55.	Lake Mathews
22.	Malibu Beach	56.	San Pedra
23.	Tapanga	57.	Seal Beach
24.	Beverly Hills	58.	Newpart Beach
25.	Hallywaad	59.	Tustin
26.	Los Angeles	60.	El Tara
27.	El Mante	61.	Santiaga Peak
28.	Baldwin Park	62.	Alberthill
29.	San Dimas	63.	Elsinare
30.	Ontaria	64.	Laguna Beach
31.	Guasti	65.	San Juan Capistrana
32.	Fantana	66.	Canada Gabernadara
33.	San Bernardino	67.	Dana Paint
34.	Redlands	68.	San Clemente

TABLE 1.2 List of U.S. Geologicol Survey 7 ½ minute quodrongles includ- ed in the Mineral Land Clossification of the Greater Los Angeles Area. Quodrongles show existing urbonized oreas, urbanizing areas, ond Mineral Resource Zones (MRZ). Quodrongles are indexed on Figure 1.3 by the obove number list.

(d) MRZ–4 Areas where available information is inadequate for assignment to any other MRZ zone.

(e) SZ Areas containing unique or rare occurrence of rocks, minerals or fossils that are of outstanding scientific signifi- cance shall be classified in this zone.

50–YEAR FORECASTS

Basis of 50–Year Forecasts

An estimate of the total quantity of sand and gravel required to supply the needs of each P–C region for the next 50 years will be presented in this series of reports in accordance with the requirements set forth in the *Guidelines for Classification and Designation of Mineral Lands* (Appendix A–3, Section I.3.c.2).

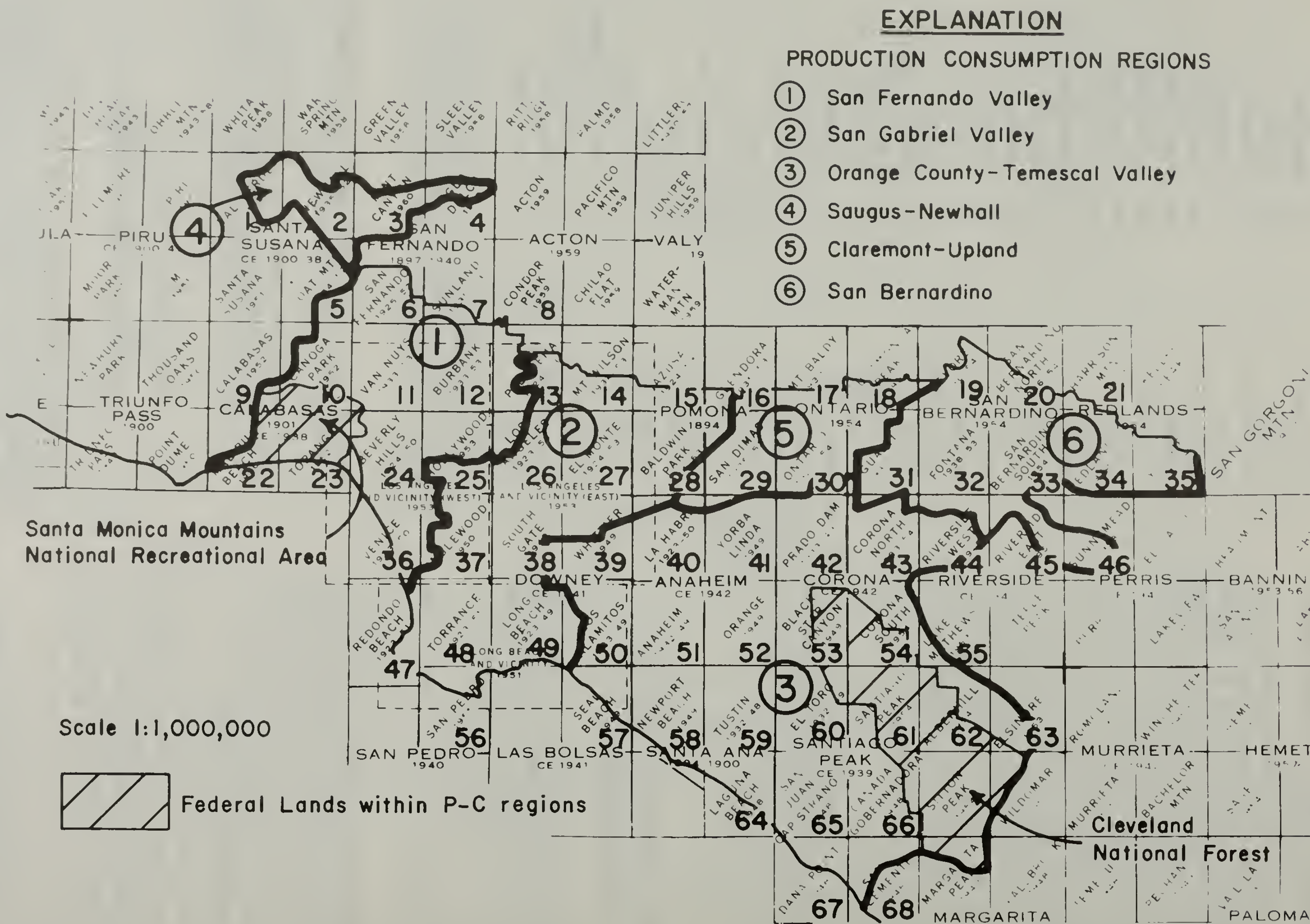


FIGURE 1.3 Index Map of U.S. Geological Survey quadrangles showing aggregate production–consumption regions of the Mineral Land Classification of the Greater Los Angeles Area. (Quadrangles numbered according to List of Quadrangles, Table 1.2).

f–year forecasts of aggregate needs are made on the basis egate that was consumed during the years 1960–75. For rposes of this project, it is assumed that all aggregate ed in a particular P–C region is also consumed within the '–C region. Consequently, aggregate consumption rates n year, in the form of per capita consumption, are comput- elating the annual population to annual aggregate produc- each P–C region.

ggregate Consumption Indicators

tionships may exist between certain indicators and the t of aggregate consumed in a P–C region through time. tors, such as the number of new residential and non- itial building permits issued, miles of new highway con- d, number of non–agricultural employees, and population were compared with aggregate production records. Simple regression analyses showed that population was the only or to maintain a strong correlation with the amount of ate consumed in each of the P–C regions.

ation and aggregate production data

18–year population record (1960–1977) was compiled for f the P–C regions established within the project area. The cal population data for this period was obtained from cal bulletins that have been published by county govern- on a quarterly or an annual basis. These statistics were ted in the form of county–wide census tract maps as in the example in Appendix B. Boundary lines for the gions were then transferred to the census tract maps, and pulations of those tracts located within a common P–C were totalled on a year by year basis. Annual aggregate ction data for the years 1970–1975 were obtained from and others (1977).

ulation projections for the years between 1979 and 2030 made for each P–C region using data furnished by county nments, the State Department of Finance (1977), and the ern California Association of Governments (1978).

capita consumption of aggregate

ple linear regression analyses of historical data were con- d to evaluate basic trends in the per capita consumption The projected per capita consumption rates of each P–C were then related to respective regional population pro- ns on a yearly basis to obtain the total aggregate needs of P–C region to the year 2030.

capita consumption rates vary greatly among the different egions of this study, apparently depending upon the degree an maturity reached by each. In the Los Angeles area, high apita consumption rates are observed to be characteristic of regions where overall population density is relatively low where rate of urban development is high. High consumption will probably be maintained in such P–C regions until th rates decline with the onset of urban maturity. As in- ed by production and population records in the Los Angeles per capita consumption then usually decreases, eventually ng off to a general maintenance level.

Population and dwelling unit densities were computed for the 1960–1976 base period in order (1) to relate and explain differences in per capita consumption rates among the six P–C regions and (2) to estimate when changes might occur in the current per capita consumption trends of urbanizing P–C regions (population statistics furnished by the counties also report the estimated number of dwelling units per census tract; Appendix B). The statistical compilation of dwelling units is limited to the years 1960, 1965, 1970, and 1976.

The acreage of each P–C region was determined by planimeter. Larger areas not suited for urban development, or set aside for other land uses, were excluded. Graphical curves depicting the 16–year records of population density, dwelling unit density, and per capita consumption of each P–C region were constructed for comparison purposes. Presentation of the above data appears in the appropriate P–C region evaluations that follow.

REPORT SUMMARIES AND RECOMMENDATIONS

At the end of each P–C region report, findings are summarized and recommendations are made to the State Mining and Geology Board. The 50–year forecasts of aggregate needs of a P–C region are compared with aggregate resources estimated to be present and available within the P–C region. (Areas of aggregate "availability" are shown as sectors on Plate 2.3 of this report.) The possibility of utilizing resources from adjacent P–C regions and the potential of sources of alternative materials (e.g. crushed rock) is considered. These facts are brought together by CDMG to apprise the Mining and Geology Board of the options that are available to provide for future resource needs, and to enable the Board to develop alternative choices for designation to be considered by lead agencies. Final determination of the designated areas will be made by the Board after consultation with lead agencies.

OVERVIEW OF AGGREGATES

Uses

Sand, gravel, and crushed rock are included among mineral commodities classed as "Construction Materials." These commodities, collectively referred to as aggregates, provide bulk and strength to Portland cement concrete, asphaltic concrete, and plaster or stucco. Aggregates are also used as road base, sub-base, and fill. Aggregates normally provide from 80 to 100 percent of the material volume in the above uses.

Economic Significance

Between 1971 and 1975 an average of 37 million tons of aggregate were produced and consumed each year in the greater Los Angeles metropolitan area (Evans and others, 1977). This amounts to about one–third of California's average annual production over the same period.

Aggregate sells for an average of about two dollars per yard at the plant site after washing, sizing, and stockpiling. However, the plant site cost of aggregate constitutes only part of the value of final Portland cement concrete when delivered to the consumer. The remainder is the cost of handling, haulage charges, mixing, and profit. Of these, haulage distance is the basic factor determining the cost of the final product at the delivery point. Therefore, it is advantageous to maintain nearby sources of aggregate.

The significance and value of aggregate as basic construction materials have multiplier effects. Aggregate is an essential part of the construction industry. Developers, building and freeway/road contractors, cement manufacturers, asphalt producers, carpenters, electricians, truck drivers, and mechanics, to name a few, depend directly or indirectly on the flow of aggregate. Therefore, the availability of aggregates and their proximity to the markets are critical factors in the strength of the economy. Hence, the aggregate industry has a disproportionately strong influence on the general economy of the greater Los Angeles metropolitan area.

Also to be considered are taxes, wages, royalties, and capital investments resulting from the aggregate industry in the greater Los Angeles metropolitan area. Total taxes paid by the industry in 1975 roughly amounted to between 10 and 12 million dollars; the total annual payroll was estimated to be 30 million dollars, royalty payments by aggregate producers to landowners amounted to roughly six million dollars, and capital investments were at least 150 million dollars (Evans and others, 1977).

Development and Production

Specifications

In past years the population centers in the greater Los Angeles metropolitan area have been served from local deposits of high quality material from which aggregate could be obtained and utilized at relatively low costs. However, high quality deposits are rapidly being depleted and many of the potential sources already have been lost to irreversible land uses incompatible with mining, such as home developments.

Furthermore, all the remaining sand, gravel, and crushed rock sources in the greater Los Angeles metropolitan area cannot be utilized in higher grade aggregate products, such as Portland cement concrete. Some deposits have been subjected to extreme weathering by groundwater or contain chemically reactive elements that make them unacceptable. Rarely is aggregate raw material at the pit or quarry site, even from the highest grade deposits, physically or chemically suited for every type of aggregate use. Therefore, every potential deposit must be tested to determine how large a tonnage of its various components can meet specifications for a particular type of use and what processing is required.

Specifications for various uses of aggregate material have been established by several agencies, such as the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and California Department of Transportation (Caltrans), to ensure that aggregate is satisfactory for particular uses. These agencies, and other major consumers of concrete, test aggregate for acceptance by standard test procedures outlined by such organizations as the American Society for Testing Materials and the American Association of State Highway Officials.

Most aggregate specifications have been established to ensure the manufacture of strong, durable concrete that will withstand the physical and chemical effects of weather and use. For ex ple, specifications for concrete and base products prohibi limit the use of rock materials containing mineral substa such as gypsum, zeolite, pyrite, opal, chalcedony, chert, silic shale, volcanic glass, and some acidic volcanic rocks. Gyp shortens the setting time of cement, pyrite dissociates to y sulfuric acid and iron oxide stain, and the other substances tain silica in a form that reacts with alkali substances in cement.

Specifications also call for varying grain–size ranges and pa cle–size distributions in the various uses of aggregate. For s uses, such as asphalt paving, particle shape is specified. Caltr Specification Standards (1975) requires that at least 25% weight of coarse aggregate (¾–inch minus material retaine the No. 4 seive) used as Class 2* aggregate base material s be crushed particles. Furthermore, aggregate material (scr ings) used with bituminous binder to form sealing coats on r surfaces shall consist of at least 90 percent by weight of crus particles. Crushed stone is preferable to natural gravel in asp tic concrete because broken surfaces adhere to asphalt be than rounded surfaces, and the interlocking of angular part strengthens the asphaltic concrete.

Aggregate for asphaltic concrete and Portland cement c crete generally meets the same physical and chemical requ ments. In localities where only one type of aggregate is rea available, that type is ordinarily used in both types of conc Most crushed rock that is produced in the Los Angeles area use in asphaltic concrete is obtained from alluvial deposits most of the larger sand and gravel plants, oversize rock c (usually larger than 1–½ inch diameter) are screened from alluvial raw material and crushed for sale as crushed ston

Production cost factors

Production costs include the cost of processing raw mate for use as aggregate and also the ensuing costs when utilizing finished aggregate material in various final products (Port cement concrete, asphaltic concrete, etc.). These costs can greatly, depending on the type of the deposit, character of deposit, and end use of the finished aggregate.

Utilization costs

The preferred use of one aggregate material over anoth construction practices depends not only on specification st ards, but also on economics. Alluvial sand and gravel is prefe to crushed stone for Portland cement concrete aggregate bec the natural material is less expensive. Also, the rounded part of alluvial sand and gravel result in a wet mix with better wo bility than with angular particles. The workability of a wet consisting of Portland cement with crushed rock aggrega improved by adding more sand and water. However, this requires that more cement be added to the mix in orde maintain concrete durability standards. Normally, the addit al cement amounts to about a quarter sack per yard of conc an additional cost of about $0.75 per yard of mix.

*Caltrans specifications for Class 2 aggregate includes: substance content, grain- distribution, particle shape, and rock quality factors.

er geologic conditions where shortages of sand and gravel rushed rock is commonly used for Portland cement con- ggregate instead of alluvial sand and gravel. Although more care is required in pouring and placing a wet mix ntains crushed rock, Portland cement concrete made with gregate is as satisfactory as that made with sand and of comparable rock quality; however, production costs are erably greater and in regions such as the Los Angeles area nal haulage costs, truck traffic, and fuel consumption result.

SUMMARY

Aggregates are an essential material to the construction industry and therefore hold great importance to the economy of the greater Los Angeles metropolitan area. Increases in the cost of supplying aggregate materials and products made with aggregate, such as transportation and processing costs, have a multiplier effect. Therefore, it is essential that nearby sources of high quality aggregate be protected against loss through careful land use planning.

REFERENCES – PART I

nia State Department of Finance, 1977, Population projecs for California counties 1975–2020 with age/sex detail to 0, series E–150, 34 p.

nia State Public Utilities Commission, 1972, Minimum rate ff 17A, naming minimum rates and rules for the transportation property in dump truck equipment from defined production as to designated delivery zones and points in southern Calinia by radial highway common carriers, highway contract riers, and dump truck carriers, revised by issuance of Supplent 6, January 19, 1974.

J.R., Anderson, T.P., Manson, M.W., Mand, R.W., Clark, B., and Fife, D.L., 1977, Aggregates in the greater Los Angeles a, California: California Division of Mines and Geology Open e Report 77–01 LA. (Final publication is in press, 1979) .

ngeles County Regional Planning Commission, 1960–1976, arterly Population and Dwelling Unit Bulletin, nos. 67, 71, 75, 83, 87, 91, 95, 99, 110, 111, 123, 127, and 131 (January issues) .

de County Planning Commission 1960–1969, Quarterly cumuve population estimates (based on April 1960 census and sequent issuance of building permits, State Department of ance estimates, and Special Census of the Census Bureau) .

Riverside County Department of Development, 1970, Census summary by tract and city, *from* U.S. Bureau of Census Information.

Riverside County Planning Department, 1971–1976, Population and dwelling units, *in* Planning News.

San Bernardino County Planning Commission, 1960–1969, Population and Housing Quarterly Bulletin, v 1, nos. 1, 5, 9, 13, 17, 21, 25, 29, 33.

San Bernardino County Planning Department, 1976 and 1978, Population–Housing Bulletin, v. 2, nos. 8 and 9 (containing population data for 1970, 1975, 1977, and 1978) .

Southern California Association of Governments, 1978, Draft SCAG –78, Growth forecast policy, *in* Development Guide, 72 p.

U.S. Geological Survey, 1976, Principles of the mineral resources classification system of the U.S. Bureau of Mines and U.S. Geological Survey, 5 p.

Ventura County Planning Department, 1960–1976, Population and Dwelling Units Bulletin, nos. 8, 12, 16, 20, 44, and 52 (population bulletin numbers for 1967, 68, 69, 70, 71, 72, 73, 74, 75 unknown) .